

Please amend the claims as follows:

[c1] (Original) A method for determining a property of a flowing fluid by nuclear magnetic resonance, comprising:

applying a static magnetic field to the flowing fluid;

acquiring a suite of nuclear magnetic resonance measurements on the flowing fluid using a pulse sequence comprising a spoiling pulse, a wait time, and an acquisition pulse sequence, wherein the suite of nuclear magnetic resonance measurements have different values for the wait time; and

fitting the suite of nuclear magnetic resonance measurements to a forward model for responses of the flowing fluid to derive a parameter selected from a flow speed, longitudinal relaxation times of the flowing fluid, and a combination thereof.

[c2] (Original) The method of claim 1, wherein the acquisition pulse sequence comprises one selected from a spin-echo pulse sequence and a single pulse.

[c3] (Original) The method of claim 1, wherein the fitting is performed by inversion of the forward model.

[c4] (Original) The method of claim 1, further comprising estimating a viscosity of the flowing fluid based on the derived flow speed and a pressure drop across a selected length of a pipe in which the flowing fluid travels.

[c5] (Original) The method of claim 4, wherein the estimating is according to one selected from

$$\eta = \frac{\Delta P \cdot r_o^2}{8 \cdot v \cdot L} \quad \text{and} \quad \eta = K \frac{\Delta P}{v},$$

where  $\eta$  is the viscosity,  $v$  is an average speed of the flowing fluid,  $L$  is the selected length of the pipe,  $\Delta P$  is the pressure drop over the selected length of the pipe, and  $r_o$  is a radius of the pipe, and  $K$  is an experimentally determined constant.

[c6] (Original) The method of claim 1, further comprising estimating a viscosity of the flowing fluid based on the derived longitudinal relaxation times and a gas-oil ratio of the flowing fluid.

[c7] (Original) The method of claim 6, wherein the estimating is according to:

$$\eta_o = \frac{k T}{T_{1,LM} f(GOR)}$$

where  $\eta_o$  is the viscosity,  $k$  is an empirically determined constant for the flowing fluid,  $T$  is a temperature in Kelvin,  $T_{1,LM}$  is a logarithmic mean of the longitudinal relaxation times of the flowing fluid, and  $f(GOR)$  is an empirically determined function of the gas-oil ratio.

[c8] (Original) A method for determining a property of a flowing fluid by nuclear magnetic resonance, comprising:

applying a static magnetic field to the flowing fluid;

acquiring a suite of nuclear magnetic resonance measurements on the flowing fluid using a pulse sequence comprising a longitudinal relaxation investigation pulse sequence and an acquisition pulse sequence, wherein the suite of nuclear magnetic measurements have different values for a delay time within the longitudinal relaxation investigation pulse; and

fitting the suite of nuclear magnetic resonance measurements to a forward model for responses of the flowing fluid to derive a parameter selected from a flow speed, longitudinal relaxation times of the flowing fluid, and a combination thereof.

[c9] (Original) The method of claim 8, wherein the longitudinal-relaxation-investigation pulse comprises one selected from a inversion-recovery pulse sequence and a saturation-recovery pulse sequence.

[c10] (Original) The method of claim 8, wherein the acquisition pulse sequence comprises one selected from a spin-echo pulse sequence and a single pulse.

[c11] (Original) The method of claim 8, wherein the fitting is performed by inversion of the forward model.

[c12] (Original) The method of claim 8, further comprising estimating a viscosity of the flowing fluid based on the derived flow speed and a pressure drop across a selected length of a pipe in which the flowing fluid travels.

[c13] (Original) The method of claim 12, wherein the estimating is according to one selected from

$$\eta = \frac{\Delta P \cdot r_o^2}{8 \cdot v \cdot L} \quad \text{and} \quad \eta = K \frac{\Delta P}{v},$$

where  $\eta$  is the viscosity,  $v$  is an average speed of the flowing fluid,  $L$  is the selected length of the pipe,  $\Delta P$  is the pressure drop over the selected length of the pipe, and  $r_o$  is a radius of the pipe, and  $K$  is an experimentally determined constant.

[c14] (Original) The method of claim 8, further comprising estimating a viscosity of the flowing fluid based on the derived longitudinal relaxation times and a gas-oil ratio of the flowing fluid.

[c15] (Original) The method of claim 14, wherein the estimating is according to:

$$\eta_o = \frac{k T}{T_{1,LM} f(GOR)}$$

where  $\eta_o$  is the viscosity,  $k$  is an empirically determined constant for the flowing fluid,  $T$  is a temperature in Kelvin,  $T_{1,LM}$  is a logarithmic mean of the longitudinal relaxation times of the flowing fluid, and  $f(GOR)$  is an empirically determined function of the gas-oil ratio.

[c16] (Original) A method for monitoring contamination in a flowing fluid being withdrawn into a formation fluid testing tool using nuclear magnetic resonance, comprising:  
 applying a static magnetic field to the flowing fluid;  
 acquiring a suite of nuclear magnetic resonance measurements of the flowing fluid using a pulse sequence comprising a spoiling pulse, a wait time, and an acquisition pulse sequence,

wherein the suite of nuclear magnetic measurements have different values for the wait time;  
fitting the suite of nuclear magnetic resonance measurements to a forward model for responses of the flowing fluid to derive a property of the flowing fluid; and  
monitoring a level of contamination in the flowing fluid based on the derived property of the flowing fluid.

[c17] (Original) The method of claim 16, wherein the property of the flowing fluid comprises one selected from a distribution of longitudinal relaxation times, a logarithmic mean of longitudinal relaxation times, and a combination thereof.

[c18] (Original) The method of claim 16, wherein the property of the flowing fluid is a viscosity.

[c19] (Presently Amended, Once) A nuclear magnetic resonance apparatus, comprising:  
a flow pipe including a prepolarization section and an investigation section, wherein the prepolarization section is upstream of the investigation section;  
a magnet disposed around the flow pipe for creating a static magnetic field covering the prepolarization section and the investigation section;  
an antenna disposed around the flow pipe at the investigation section for generating an oscillating magnetic field having a magnetic dipole substantially perpendicular to a magnetic dipole of the static magnetic field, and for receiving a nuclear magnetic resonance signal; and  
a circuitry for controlling generation of the oscillating magnetic field and reception of the nuclear magnetic resonance signal by the antenna, wherein the circuitry includes a program having instructions for acquiring a suite of nuclear magnetic resonance measurements of a flowing fluid using a pulse sequence comprising a spoiling pulse, a wait time, and an acquisition pulse sequence.

[c20] (Presently Cancelled)

[c21] (Presently Amended, Once) The apparatus of claim 2019, wherein the acquisition pulse sequence comprises one selected from a spin-echo pulse sequence and a single pulse.

- [c22] (Original) The apparatus of claim 20, wherein the program further comprises instructions for fitting the suite of nuclear magnetic resonance measurements to a forward model for responses of a flowing fluid to derive a parameter selected from a flow speed, longitudinal relaxation times of the flowing fluid, and a combination thereof.
- [c23] (Original) The apparatus of claim 22, wherein the fitting is performed by inversion of the forward model.
- [C24] (Original) The apparatus of claim 22, wherein the program further comprising instructions for estimating a viscosity of the flowing fluid based on the derived flow speed or the derived longitudinal relaxation times.
- [c25] (New) A nuclear magnetic resonance apparatus, comprising:  
a flow pipe including a prepolarization section and an investigation section, wherein the prepolarization section is upstream of the investigation section;  
a magnet disposed around the flow pipe for creating a static magnetic field covering the prepolarization section and the investigation section;  
an antenna disposed around the flow pipe at the investigation section for generating an oscillating magnetic field having a magnetic dipole substantially perpendicular to a magnetic dipole of the static magnetic field, and for receiving a nuclear magnetic resonance signal; and  
a circuitry for controlling generation of the oscillating magnetic field and reception of the nuclear magnetic resonance signal by the antenna, wherein the circuitry includes a program having instructions for acquiring a suite of nuclear magnetic resonance measurements of a flowing fluid using a pulse sequence comprising a longitudinal relaxation investigation pulse sequence and an acquisition pulse sequence, wherein the suite of nuclear magnetic measurements have different values for a delay time within the longitudinal relaxation investigation pulse.
- [c26] (New) The apparatus of claim 25, wherein the acquisition pulse sequence comprises one selected from a spin-echo pulse sequence and a single pulse.

- [c27] (New) The apparatus of claim 25, wherein the program further comprises instructions for fitting the suite of nuclear magnetic resonance measurements to a forward model for responses of a flowing fluid to derive a parameter selected from a flow speed, longitudinal relaxation times of the flowing fluid, and a combination thereof.
- [c28] (New) The apparatus of claim 27, wherein the fitting is performed by inversion of the forward model.
- [C29] (New) The apparatus of claim 27, wherein the program further comprising instructions for estimating a viscosity of the flowing fluid based on the derived flow speed or the derived longitudinal relaxation times.

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**